### BME SECOND YEAR: THIRD SEMESTER

#### A. THEORY

<table>
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<tr>
<th>Sl.No.</th>
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#### B. PRACTICAL

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### BME SECOND YEAR: FOURTH SEMESTER

#### A. THEORY

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@ The Professional core of one discipline may be taken as Free Elective of the other. For this a scope for including the tutorial as in the Professional core has been included. This will make the credit points earned a little in excess. This gives a variation in the credit points earned.

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* There may be a limited choice between only two papers which become quasi compulsory.
## Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

### Fourth Year - Seventh Semester

<table>
<thead>
<tr>
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* One may be the P.C. of a different discipline.

### Fourth Year - Eighth Semester

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<td>Artificial Organs &amp; Rehabilitation Engineering</td>
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<td>Lasers &amp; Fiber Optics in Medicine</td>
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<td>BME-802A</td>
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<td>Medical Informatics</td>
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* Depending on the type of electives chosen, total credit points may vary from 212 to 218. Average credits earned is 215.

* If the total credit points earned is to be reduced below the minimum credit points of 210, then the Professional & Free Electives that are be taken in the final semester may be termed as Audit point papers. This will bring down the range of credit points earned from the range 210-218 to 204-214. But this will be a marginal reduction.
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

Syllabus for B.Tech (BME) Second Year

SEMESTER – III

THEORY

NUMERICAL METHODS
Code: M (CS) 301 Contacts: 2L Credits: 2

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)

Interpolation: Newton forward & backward interpolation, Lagrange’s and Newton’s divided difference Interpolation. (5)

Numerical integration: Trapezoidal rule, Simpson’s 1/3 rule, Weddle’s rule. (3)

Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Jacobi and Gauss-Seidel iterative methods. (6)

Numerical solution of Algebraic equation: Bisection method, Secant method, Regula-Falsi method, Newton-Raphson method. (4)


Text Books:

References:
2. Baburam: Numerical Methods, Pearson Education.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP
5. Srimanta Pal: Numerical Methods, OUP.

MATHEMATICS-III
Code: M 302 Contacts: 3L +1T Credits: 4

Note 1: The whole syllabus has been divided into five modules.
Note 2: Structure of the question paper
There will be three groups in the question paper. In Group A, there will be one set of multiple choice type questions spreading the entire syllabus from which 10 questions (each carrying one mark) are to be answered. From Group B, three questions (each carrying 5 marks) are to be answered out of a set of questions covering all the three modules. Three questions (each carrying 15 marks) are to be answered from Group C. Each question of Group C will have two or three parts covering not more than two modules. Sufficient questions should be set covering the whole syllabus for alternatives.

Module I
Fourier Series:
Introduction, Periodic functions, Even and odd functions, Special waveforms, Euler’s formulae for Fourier’s coefficients, Dirichlet’s conditions and sum of the Fourier series, Half range Fourier series, Parseval’s identity (Statement only).

Fourier Transform: Fourier Transform and its properties, Inverse Fourier Transform (Statement only), Fourier Transform of derivatives (Statement only), Convolution theorem (Statement only). Related problems. (8L)

Module II
Calculus of Complex variable:
Functions, Limit and Continuity, Analytic functions, Cauchy-Riemann equations
**Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year**

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

(Statement only) and related problems, Analytic continuation, Complex integration and Cauchy’s theorem (Statement only), Cauchy’s integral formula (Statement only), Taylors and Laurent series, Zeros of an analytic function, Poles, Essential singularities, Residue theorem (Statement only) and its application to evaluation of definite integrals (Elementary cases only), Introduction to Conformal Mapping. (12L)

**Module III**

**Probability:**

Axiomatic definition of probability, Conditional probability, Independent events, Related problems, Bayes theorem (Statement only) & its application. One dimensional random variable, Probability distributions-discrete and continuous, Expectation, Binomial, Poisson, Uniform, Exponential and Normal distribution, Problems on Binomial, Poisson and Normal distribution only. (12L)

**Module IV**

**Partial Differential Equations:**

Solution of one dimensional wave equation, One dimensional heat-conduction equation, Laplace equation in two dimension by the methods of

1: Separation of variables 2: Integral Transforms (Laplace and Fourier Transforms) (6L)

**Module V**

**Series solution of Ordinary Differential equation:**

Introduction, validity of series solution of an ordinary differential equation, general method to solve equation of the type: \( P_0 y'' + P_1 y' + P_2 y = 0 \), related problems, Bessel’s equation, properties of Bessel’s function, Recurrence formula for Bessel’s function of first kind, Legendre’s equation, Legendre function; Recurrence formula for Legendre function \((P_n(x))\); Orthogonality relation. (10L)

**Text Books:**

2. Das N.G.: Statistical Methods, TMH.
5. Lipschutz S., and Lipson M.L.: Probability (Schaum's Outline Series), TMH.

**References:**

5. Ramana B.V.: Higher Engineering Mathematics, TMH.

**BIOPHYSICAL SIGNALS AND SYSTEMS**

**Code:** BME 301  **Contacts:** 3L  **Credits:** 3

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<th>Content</th>
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<td>1</td>
<td>Signals and systems: Continuous time (CT) signals, Discrete time (DT) signals, periodic, aperiodic, random, energy and power signals, step, ramp, impulse and exponential function, Transformation in independent variable of signals: time scaling, time shifting and time inverting, classification and properties of systems. LTI systems - convolution and stability, physiological signals and their properties, Time invariant and time varying physiological systems.</td>
<td>6</td>
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<tr>
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<td>Signal analysis: Basic concepts and development of the Fourier Series, Determination of the Fourier series representation of Continuous and Discrete time periodic signal, Properties of continuous and discrete time Fourier series, Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT), ECG signal analysis.</td>
<td>6</td>
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<td>3</td>
<td>Sampling Theorem and Z-Transforms: Representation of continuous time signals by its sample, Sampling theorem, Reconstruction of a Signal from its samples, aliasing, Basic principles of z-transform, z-transform definition, Properties of z-transform, Poles and Zeros, inverse z-transform.</td>
<td>6</td>
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<tr>
<td>4</td>
<td>Noise and Feed Back System: Sources and types of noise, noise factor and temperature, equivalent noise resistance and noise factor in cascade amplifier, Basic Feedback concept, Positive and Negative Feedback, Sensitivity analysis, Effect of Feedback on disturbance or Noise, Distortion analysis by Feed Back, Control system, Open loop Control System, Control system With Feed Back, Application of feed back in physiological systems and its importance.</td>
<td>8</td>
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<tr>
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<td>Filtering Techniques: Types of filter (Active and Passive), General idea of LPF, HPF, BPF and N.F. First order Passive Filters (L.P., H.P. B.P &amp; N.F), First order active filter (L.P. H.P. B.P &amp; N.F), use of filter for biomedical signal analysis, design of filter suitable for Bio-medical signal analysis.</td>
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Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

Physiological System: Block diagram representation of cardio vascular system, Electrical circuit model of Blood Pressure, Electrical analog of blood vessels and its transfer function, model of coronary circulation ant its analysis, Germ, Plasma cell, Antibody, system equation and transfer function. Application of feedback and block diagram reduction techniques.

Reference Books:
2. Hayken & Van Veen- Signal & System,Willey
5. Gayakward-Opamps and Linear Integrated Circuits , Prentice Hall India

CIRCUIT THEORY & NETWORKS
Code: BME (EC) 301
Contacts: 3L
Credits: 3

<table>
<thead>
<tr>
<th>M#</th>
<th>Content</th>
<th>Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resonant Circuits: Series and Parallel Resonance, Impedance and Admittance Characteristics, Quality Factor, Half-Power Points, Bandwidth, Resonant voltage rise, Transform diagrams, Solution of Problems</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Mesh Current Network Analysis: Kirchhoff’s Voltage Law, Formulation of Mesh Equations, Solution of mesh equations by Cramer’s rule and matrix method, Driving point impedance, Transfer impedance, Solutions of Problems with DC and AC sources</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Node Voltage Network Analysis: Kirchhoff’s Current Law, Formulation of node equations and solutions, Driving point admittance, Solutions of Problems with DC and AC sources</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Network Theorems: Definition and Implications of Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman’s Theorem, Star-Delta Transformations, Solutions and Problems with DC and AC sources</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Graph of Network: Concept of Tree Branch, Tree link, junctions, Incident matrix, Tie-set matrix, Cut-set matrix, determination of loop current and node voltages.</td>
<td>4</td>
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<tr>
<td>6</td>
<td>Coupled Circuits: Magnetic Coupling, polarity of coils, polarity of induced voltage, concept of self and mutual inductance, coefficient of coupling, Solution of Problems</td>
<td>2</td>
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<tr>
<td>7</td>
<td>Circuit Transients: DC Transient in R-L &amp; R-C circuits with and without initial charge, R-L-C circuits, AC transients in sinusoidal R-L, R-C, &amp; R-L-C circuits, solution of problems</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Laplace Transform: Concept of complex frequency, transformation of f(t) into F(s), transformation of step, exponential, overdamped surge, critically damped surge, damped sine, undamped sine functions, properties of Laplace Transform, linearity, real-differentiation, reintegration, Initial Value Theorem and Final Value Theorem, Inverse Laplace Transform, applications in circuit analysis, Partial Fractions expansion, Heaviside’s Expansion Theorem, solution of problems</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>SPICE: Introduction, model statement, elementary DC and small-signal analysis.</td>
<td>2</td>
</tr>
</tbody>
</table>

Text Books:
1. Valkenburg M. E. Van, Network Analysis, Prentice Hall./Pearson Education
3. D.A.Bell- Electrical Circuits- Oxford

References:
1. A.B.Carlson-Circuits- Cengage Learning
7. P.Ramesh Babu- Electrical Circuit Analysis- Scitech
10. Sivandam- “Electric Circuits and Analysis”, Vikas
13. M. H. Rashid:Introduction to PSpice using OrCAD for circuits and electronics, Pearson

ENGINEERING PHYSIOLOGY & ANATOMY
Code: BME 302
Contacts: 3L +1L
Credits: 4

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<thead>
<tr>
<th>M#</th>
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<tbody>
<tr>
<td>1</td>
<td>Cell: Cell membrane and organelles, Ion channels, Receptors and carriers, Intercellular communication, Membrane potential, Action Potential, Generation and Conduction, Blood Cells, Origin of RBC, structure and function of haemoglobin, Plasma proteins, Bone marrow, Hematocrit, ESR and its significance, Blood volume regulation, blood coagulation and factors, Bleeding and clotting time.</td>
<td>8</td>
</tr>
</tbody>
</table>

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Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

ANALOG ELECTRONIC CIRCUITS
Code: BME (EC) 304
Contacts: 3L + 1L
Credits: 4

<table>
<thead>
<tr>
<th>M#</th>
<th>Content</th>
<th>Hrs</th>
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<tbody>
<tr>
<td>1</td>
<td>Filters and Regulators: Capacitor filter, π-section filter, ripple factor, series and shunt voltage regulator, percentage regulation, 78xx and 79xx series, concept of SMPS</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Transistor Basing and Stability: Q-point, Self Bias-CE, Compensation techniques, h-model of transistors. Expression for voltage gain, current gain, input and output impedance, trans-resistance &amp; trans-conductance; Emitter follower circuits, High frequency model of transistors.</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Transistor Amplifiers: RC coupled amplifier, functions of all components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier.</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Feedback Amplifiers &amp; Oscillators: Feedback concept, negative &amp; positive feedback, voltage/ current, series/shunt feedback, Berkhhausen criterion, Colpitts, Hartley’s, Phase shift, Wien bridge and crystal oscillators.</td>
<td>4</td>
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<tr>
<td>5</td>
<td>Operational Amplifier: Ideal OPAMP, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Open &amp; Closed loop circuits, importance of feedback loop (positive &amp; negative), inverting &amp; non-inverting amplifiers, voltage follower/buffer circuit.</td>
<td>6</td>
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<tr>
<td>6</td>
<td>Applications of Operational Amplifiers: adder, integrator &amp; differentiator, comparator, Schmitt Trigger, Instrumentation Amplifier, Log &amp; Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier, Voltage to current and current to voltage converter, free running oscillator.</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Power amplifiers – Class A, B, AB, C, Conversion efficiency, Tuned amplifier</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Multivibrator: Monostable, Bistable, Astable multivibrators; Monostable and astable operation using 555 timer.</td>
<td>2</td>
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<tr>
<td>9</td>
<td>Special Functional Circuits: VCO and PLL.</td>
<td>2</td>
</tr>
</tbody>
</table>

Text Books:
1. Sedra & Smith-Microelectronic Circuits - Oxford UP

References:
2. Rashid-Microelectronic Circuits-Analysis and Design-Thomson (Cengage Learning)
4. Razavi- Fundamentals of Microelectronics - Wiley
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
9. Gayakwad R.A.– OpAmps and Linear IC’s, PHI
10. Coughlin and Driscoll—Operational Amplifier and Linear Integrated Circuits–Pearson Edn
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

PRACTICAL

NUMERICAL METHODS LABORATORY
Code : M(CS) 391 Contacts: 2P Credits :1

1. Assignments on Newton forward & backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson’s 1/3 rule, Weddle’s rule.
4. Assignments on numerical solution of Algebraic Equation by Bisection, Secant, Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Taylor series, Euler’s, Runga-Kutta and Finite difference methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

BIOPHYSICAL SIGNALS & SYSTEMS LABORATORY
Code : BME 391 Contacts: 3P Credits :2

The following simulation exercise should be carried out in MATLAB or C programming.

1. Familiarization with MATLAB and generation of various types of waveforms (sine, cosine, square, triangular etc.).
2. Generation of different functions (unit impulse, unit step, RAMP, etc.)
3. Find out the signal energy and power
4. Generation of various types of noise (uniform white, Gaussian, coloured etc.).
5. Analysis CTFT & DTFT
6. To study Z- transform of: a) Sinusoidal signals b) Step functions.
7. To study LPF & HPF; band pass and reject filters using RC circuits
8. ECG signal analysis / Equivalent electrical circuit analysis of blood vessels

CIRCUITS & NETWORKS LABORATORY
Code : BME(EC) 391 Contacts: 3P Credits :2

1. Characteristics of Series & Parallel Resonant circuits
2. Verification of Network Theorems
3. Transient Response in R-L & R-C Networks ; simulation / hardware
4. Transient Response in RLC Series & Parallel Circuits & Networks; simulation / hardware
5. Determination of Impedance (Z), and Admittance (Y) parameters of Two-port networks
6. Generation of periodic, exponential, sinusoidal, damped sinusoidal, step, impulse, and ramp signals using MATLAB
7. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB
8. Determination of Laplace Transform, different time domain functions, and Inverse Laplace Transformation using MATLAB

Note: An Institution / college may opt for some other hardware or software simulation wherever possible in place of MATLAB

PHYSIOLOGY LABORATORY
Code : BME 392 Contacts: 3P Credits :2

1. Identification of histological slides – nerve tissues (cerebellum, cerebral cortex, neurons, spinal cord, nodes of Ranvier, corneal cell space), renal tissues. Blood vessels (artery & vein), skin, tongue, liver.
3. Measurement of TC of RBC & WBC & DC of WBC.
4. Determination of ESR
5. Determination of BT, CT
6. Determination of Blood Group ( ABO; Rh).
7. Hemoglobin estimation
8. Determination of blood pressure

ANALOG ELECTRONIC CIRCUITS LABORATORY
Code : BME(EC) 394 Contacts: 3P Credits :2

1. Study of Diode as clipper & clamper
2. Study of Zener diode as a voltage regulator
3. Study of ripple and regulation characteristics of full wave rectifier without and with capacitor filter
4. Study of characteristics curves of B.J.T & F.E.T.
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
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5. Construction of a two-stage R-C coupled amplifier & study of it’s gain & Bandwidth.
6. Study of class A & class B power amplifiers.
7. Study of class C & Push-Pull amplifiers.
11. Construction of a simple function generator using IC.
14. Construction of a simple function generator using IC.
16. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
17. Study of D.A.C & A.D.C.

SEMESTER – IV

THEORY

VALUES & ETHICS IN PROFESSION

Code: HU 401   Contacts: 3L     Credits: 3

Science, Technology and Engineering as knowledge and as Social and Professional Activities

Effects of Technological Growth:
Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing nations. Problems of Technology transfer, Technology assessment impact analysis.

Ethics of Profession:
Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Profession and Human Values:
Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity
Moral and ethical values: Nature of moral judgements; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.

Books:

BIOPHYSICS & BIOCHEMISTRY

Code: BME(PH) 401   Contacts: 3L+1T     Credits: 4

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<tr>
<th>M#</th>
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<tbody>
<tr>
<td>1</td>
<td>Biophysical principles: Composition &amp; properties of the cell membrane, membrane transports, permeability. Coefficient &amp; partition coefficient, body fluids, electrolytes, acid-base balance, blood viscosity and Newtonian nature, colloids, filtration, diffusion, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, plasmapheresis, radioimmunoassay, Photochemical reaction, law of photochemistry, fluorescence and phosphorescence.</td>
</tr>
<tr>
<td>2</td>
<td>Bioelectricity: Membrane Potential, Local and propagator types, Diffusion potential, phase boundary potentials, Generator Potentials, compound Action Potentials (AP), Propagation of AP, factors influencing propagation of AP, biosignal and types, Electrical properties of excitable membranes, Membrane Capacitance, Resistance, conductance, dielectric properties of membrane, space and time constant for excitable membrane, equivalent electrical circuit diagram for excitable membranes and neural membranes.</td>
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Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

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<th>3</th>
<th>Electrical stimulus &amp; Biophysical activity: Stimuli, Receptor potential, pacemaker potential, strength-duration relationship, skin impedance, total body impedance, impedances at high frequencies, patient safety, electrical shock and hazards, leakage current, Electrical activity of brain (EEG), different wave forms &amp; their characteristics, Electrical activity of heart (ECG), waveform and significance, Electrical activity of muscles (EMG) and muscle tone, Electro-RetinoGram(ERG), Electro-Occhlogram (EOG)</th>
</tr>
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<tr>
<td>4</td>
<td>Radioactivity: Ionizing radiations, U-V &amp; I-R radiations, Production of radioisotopes &amp; their use in biomedical research, radioactive decays, Half life period, Linear Energy Transfers (LET), Relative Biological Efficiency (RBE) and Interaction of radiation with matter</td>
</tr>
<tr>
<td>5</td>
<td>Macromolecules: Classification and functions of carbohydrates, glycolysis, TCA cycle, ATP synthesis, Blood Sugar analysis and glucose tolerance test, Classification and functions of proteins, architecture of proteins, Classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, oxalate cycle, Purification/separation of proteins, Classification and functions of lipids, biosynthesis of long chain fatty acids, oxidation and degradation of fatty acids</td>
</tr>
<tr>
<td>6</td>
<td>Enzymes and Nucleic acids: Chemical nature and broad classification of enzymes, M-M-Kinetics, Isozymes and Allosteric enzymes, Isolation techniques, Structure of DNA, Genetic code, Recombinant DNA, Transcription &amp; Translation, Reverse Transcription, Replication</td>
</tr>
</tbody>
</table>

Reference Books:
3. Text book of Medical Physiology- Guyton 

BASIC ENVIRONMENTAL ENGINEERING & ELEMENTARY BIOLOGY

Code: CH 401     Contacts: 3L     Credits: 3

General
Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. 1L
Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-a-vis population growth, Sustainable Development. 2L
Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. 1L
Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. 2L

Ecology
Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function. 1L
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. 2L
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. 1L
Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 2L
Air pollution and control

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.

1L

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. 1L

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence; Control of Global warming. Earth’s heat budget. 1L

Lapse rate: Ambient lapse rate, Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). 2L

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. 2L

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. 2L

Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate PAN. 2L

Smog, Photochemical smog and London smog. 2L

Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other greenhouse gases, effect of ozone modification. 1L

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). 1L

Water Pollution and Control

Hydrosphere, Hydrological cycle and Natural water.

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. 2L

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. 2L

Lake: Eutrophication [Definition, source and effect]. 1L

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) 1L

Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]. 1L

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. 2L

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic 1L

Land Pollution

Lithosphere; Internal structure of earth, rock and soil 1L

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method. Open dumping, Land filling, incineration, composting, recycling. 1L
Solid waste management and control (hazardous and biomedical waste).  

Noise Pollution
Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]  
1L
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, \[ L_{10} \] (18 hr Index), \[ L_d \].  
1L
Noise pollution control.

Environmental Management:
Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.  
2L

References/Books

BIOSENSORS & TRANSDUCERS
Code: BME 402  
Contacts: 3L+1T  
Credits: 4

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<tbody>
<tr>
<td>1</td>
<td>Transducers principles and Medical applications: Classification of transducers, characteristic of transducers, Temperature transducers: Resistance temperature detector (RTD), Thermistor, Thermocouple, p-n junction, chemical thermometry, Displacement transducers: potentiometer, resistive strain gauges, inductive displacement, capacitive displacement transducer, Pressure transducer: variable capacitance pressure transducers, LVDT transducers, strain gauge transducers, semiconductor transducers, catheter tip transducers, Piezoelectric transducer, Photoelectric transducers: photo-emissive tubes, photovoltaic cell, photoconductive cell, photodiodes, Flow transducers: magnetic, resistive and ultrasonic</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Biochemical Transducers: Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, Biopotential electrodes: microelectrodes, body surface electrodes, needle electrodes, electrodes for ECG, EEG, and EMG Reference electrodes: hydrogen electrodes, O₂, CO₂, electrodes</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Optical Sensor and Radiation Detectors: Principles of optical sensors, optical fiber sensors, indicator mediated transducers, optical fiber temperature sensors, Proportional counter, Gas- ionisation chamber, Geiger counters, Scintillation detectors.</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Biological sensors: Sensors 7 receptors in the human body, basic organization of nervous system-neural mechanism, Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors &amp; BIOMEMS, basic idea about Smart sensors.</td>
<td>6</td>
</tr>
</tbody>
</table>

Reference Books:
6. Ribarli & Guyton, Regulation & Control in Physiological System, Instruments Soc.USA.

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS
Code: BME(EC) 402  
Contacts: 3L+1T  
Credits: 4

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<tbody>
<tr>
<td>1</td>
<td>Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD,ASCII, EBDIC; Gray codes and their conversions; Signed binary number representation with 1’s and 2’s complement methods; Binary arithmetic.</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Venn diagram, Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method and Quine-McClauskey method</td>
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3 Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator. 5
4 Memory Systems: RAM, ROM, EPROM, EEPROM 4
5 Design of combinational circuits using ROM, Programming logic devices and gate arrays (PLAs and PLDs) 4
6 Sequential Circuits - Basic memory element-S-R, J-K, D and T Flip Flops, various types of Registers and counters and their design, Irregular counter, State table and state transition diagram, sequential circuits design methodology. 6
7 Different types of A/D and D/A conversion techniques. 4
8 Logic families - TTL, ECL, MOS and CMOS, their operation and specifications. 6

Text Books:
1. Anand Kumar, Fundamentals of Digital Circuits- PHI
2. A.K.Maini- Digital Electronics- Wiley-India

References:
1. Morries Mano- Digital Logic Design- PHI
2. R.P.Jain—Modern Digital Electronics, 2/e, Mc Graw Hill
6. Tocci, Widmer, Moss- Digital Systems, 9/e- Pearson
11. P Raja- Digital Electronics- Scitech Publications

Practical

COMMUNICATION SKILL & REPORT WRITING
Code: HU 481 Contacts: 3P Credits: 2

Guidelines for Course Execution:

Objectives of this Course: This course has been designed:
1. To inculcate a sense of confidence in the students.
2. To help them become good communicators both socially and professionally.
3. To assist them to enhance their power of Technical Communication.

Detailed Course Outlines:
A. Technical Report Writing : 2L+6P
1. Report Types (Organizational / Commercial / Business / Project )
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)

B. Language Laboratory Practice
1. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory Practice Sessions 2L
2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P
   a) Training the students by using Language Lab Device/Recommended Texts/cassettes/cd’s to get their Listening Skill & Speaking Skill honed
   b) Introducing Role Play & honing over all Communicative Competence
3. Group Discussion Sessions: 2L+6P
   a) Teaching Strategies of Group Discussion
   b) Introducing Different Models & Topics of Group Discussion
   c) Exploring Live /Recorded GD Sessions for mending students’ attitude/approach & for taking remedial measure
4. Interview Sessions: 2L+6P
   a) Training students to face Job Interviews confidently and successfully
   b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication

4. Presentation: 2L+6P
   a) Teaching Presentation as a skill
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

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b) Strategies and Standard Practices of Individual/Group Presentation
c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids

5. Competitive Examination:  2L+2P
   a) Making the students aware of Provincial/National/International Competitive Examinations
   b) Strategies/Tactics for success in Competitive Examinations
   c) SWOT Analysis and its Application in fixing Target

Books – Recommended:
Nira Konar: English Language Laboratory: A Comprehensive Manual

References:
Adrian Duff et. al. (ed.): Cambridge Skills for Fluency
   A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
   B) Listening (Levels 1-4 Audio Cassettes/Handbooks)
   Cambridge University Press 1998

Mark Hancock: English Pronunciation in Use
   4 Audio Cassettes/CD'S  OUP 2004

BIOPHYSICS & BIOCHEMISTRY LABORATORY
Code: BME 491   Contacts: 3P     Credits: 2

2. Measurement of viscosity of Blood
3. Measurement of skin impedance (GSR)
4. Recording and analysis of ECG
5. Recording and analysis of EMG / EEG
6. Determination of muscle Threshold (Fatigue, Twitch, Summation, Incomplete & complete Tetanus)
7. Quantitative estimation of glucose (spectrophotometer / colorimeter)
8. Quantitative estimation of proteins (spectrophotometer / colorimeter)

BIOSENSORS & TRANSDUCERS LABORATORY
Code: BME 492   Contacts: 3P     Credits: 2

1. Temperature measurement using AD590 IC sensor
2. Displacement measurement by using a capacitive transducer
3. Study of the characteristics of a LDR
4. Pressure and displacement measurement by using LVDT
5. Study of a load cell with tensile and compressive load
6. Torque measurement Strain gauge transducer
7. Study & characterization of Biotransducers – Pressure, Temperature, Humidity
8. Study & characterization of Bioelectrodes – ECG, EMG, EEG

DIGITAL ELECTRONICS & INTEGRATED CIRCUITS LABORATORY
Code: BME(EC) 492   Contacts: 3P     Credits: 2

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Four-bit parity generator and comparator circuits.
4. Construction of simple Decoder and Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
8. Realization of Universal Register using JK flip-flops and logic gates.
13. Design of Sequential Counter with irregular sequences.
14. Realization of Ring counter and Johnson’s counter.
15. Construction of adder circuit using Shift Register and full Adder.
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

SEMESTER – V

THEORY

Economics for Engineers
HU-501
Contracts: 3L  Credits- 3

9. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.

Readings
2. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
5. R.Paner Seelvan: Engineering Economics, PHI

Biomedical Instrumentation
Code: BME 501
Contact: 3L + IT  Credit: 4

<table>
<thead>
<tr>
<th>Medical Instrumentation: Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, Microprocessors in medical instruments, PC based medical Instruments, General constraints in design of medical Instrumentation system, Regulation of Medical devices.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement systems: Specifications of instruments, Static &amp; Dynamic characteristics of medical instruments, Classification of errors, Statistical analysis, Reliability, Accuracy, Fidelity, Speed of response, Linearization of technique, Data Acquisition System.</td>
</tr>
<tr>
<td>Bioelectric signals and Bioelectric amplifiers: Origin of bioelectric signals, Electrodes, Electrode-tissue interface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector.</td>
</tr>
<tr>
<td>Biomedical recording systems: Basic Recording systems, General consideration for signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrocardiograph, Vectorcardiograph, Phonocardiograph, Electroencephalograph, Electromyography, Other biomedical recorders, Biofeedback instrumentation, Electrostatic and Electromagnetic coupling to AC signals, Proper grounding, Patient isolation and accident prevention.</td>
</tr>
<tr>
<td>Patient Monitoring Systems: System concepts, Cardiac monitor, selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, Holter monitor and Cardiac stress test, Cardiac cauterization instrumentation, Organization and equipments used in ICCU &amp; ITU.</td>
</tr>
</tbody>
</table>

Total 40L
**Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year**

*Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011*  

### Text Books:

### References:

### Analytical & Diagnostic Equipments

**Code: BME 502**

**Contact:** 3L + IT  
**Credit:** 4


- **Blood gas analyzers and Oximeters:** Blood pH measurement, Blood pCO₂ measurement, Blood pO₂ measurement, a complete blood gas analyzer, Fiber optic based blood gas sensors, Oximeter, Principles of oximetric measurements, Ear oximeter, Pulse oximeter, Intravascular oximeter.

- **Blood cell counters and Blood pressure apparatus:** Methods of cell counting, Flow cytometry, Coulter Counters, automatic recognition and differential counting of cells, Sphygmomanometer, Automated indirect and Specific direct method of B.P. monitor.

- **Blood Flow meters:** Electromagnetic blood flow meter, Ultrasonic blood flow meter-Transit time and Doppler blood flow meter, Cardiac output measurement-Dye dilution method and Impedance technique.

- **Pulmonary function analyzers:** Respiratory volumes and capacities, Compliance and related pressure, Spirometer, Pneumotachometer, impedance pneumograph / plethysmograph, apnea detector.

- **Endoscopy:** Basic endoscopic equipments, Fibreoptic instruments and video-endoscopes, Accessories-illumination, instrument tips, instrument channels, tissue sampling devices, suction traps and fluid-flushing devices, Various endoscopic applications.

<table>
<thead>
<tr>
<th><strong>Text Books:</strong></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th><strong>References:</strong></th>
</tr>
</thead>
</table>

### Communication Engineering & Bio-Telemetry

**Code: BME 503**

**Contact:** 3L  
**Credit:** 3

- **Introduction:** Elements of analog and digital communication system, Baseband communication, Carrier communication, Concept of Modulation, Source coding, Channel coding.

- **Analog Communication:** Amplitude modulation (AM)-Frequency domain & time domain representation, Modulation index, Transmission bandwidth, Single tone & multitone modulation, Power calculation for single tone, Generation and demodulation of AM, Generation and demodulation of Single side band modulation (SSB), Generation and demodulation of Double side band suppressed carrier modulation (DSBSC/DSB), Super heterodyne receiver for AM Radio, Angle Modulation(FM/PM)- Frequency modulation, Phase modulation, Time & frequency domain representation of FM, Narrow band & wideband FM, Generation and detection of FM, Introduction to Phase-Locked-Loop(PLL), Demodulation of PM using PLL.

- **Digital Communication:** Concept of sampling, Pulse Amplitude Modulation(PAM), Pulse Code Modulation(PCM), delta modulation and adaptive delta modulation, Digital transmission, Line coding- Unipolar, Polar, NRZ, RZ, Manchester and AMI, Coding control, Digital Modulation Techniques-ASK, PSK, FSK and QPSK, Multiplexing-FDM and TDM.

- **Bio-Telemetry System:** Components of telemetry system, Bio-telemetry and its importance, Single and multi-channel biotelemetry, ECG telemetry system, Temperature telemetry system, Telemetry of ECG and Respiration, Sports telemetry, Multi-patient telemetry, Ambulatory patient monitoring, Implantable telemetry systems, transmission of physiological signals over telephone line, Telemedicine and applications.

| **Total:** 40L
Text Books:
2. B.P.Lathi -Communication Systems- BS Publications
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. S. Haykin, Digital Communications, Wiley India

References:
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
4. P K Ghosh- Principles of Electrical Communications- University Press
5. Blake, Electronic Communication Systems- Cengage Learning
6. S Sharma, Analog Communication Systems- Katson Books/Millman & Halkias,

Data Structure & C
Code: BME-504A
Contacts: 3L +1T  Credits: 4

Module - I: [8L] Linear Data Structure
Introduction (2L):
Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.

Array (2L):
Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List (4L):
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module - II: [7L] Linear Data Structure
(Stack and Queue (5L)):
Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications.

Recursion (2L):

Module - III. [15L] Nonlinear Data structures
Trees (9L):
Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-reversive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching), Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs (6L):
Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cutvertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim’s algorithm (basic idea of greedy methods).

Module - IV. Searching, Sorting (10L):
Sorting Algorithms (5L):
Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort.

Searching (2L):
Sequential search, binary search, interpolation search.

Hashing (3L):
Hashing functions, collision resolution techniques.

Recommended books:
Object Oriented Programming & JAVA
Code: BME-504B
Contacts: 3L + 1T  Credits: 4

Module-1:  [10L]
Introduction:

Object oriented design:
Major and minor elements, class fundamentals. [1L]; Declaring objects, instantiation of class, introducing methods. [1L]; Constructing objects using constructor. [1L]; Static variable, constants. [1L]; Visibility modifiers. [1L]

Learning outcome of Introduction of OOP: Students will be able to implement basic data structure and control statements in object oriented programming. They can write programs around its data i.e, objects and a set of well-defined interfaces to that data. Student will be able to design class with its basic features.

Module-2:  [8L]
Object Properties:
Introduction to basic features of a class (encapsulation, polymorphism etc) [1L]; Data field encapsulation. [1L]; Passing objects to methods. [1L]; Array of objects, ‘This’ keyword [1L]; Relationships among objects; aggregation, composition, dependency, links. [1L]; Relationship among classes: association, aggregation. [1L] Meta class, meta object. [1L]; Grouping constructs. [1L] Learning outcome of Object oriented design: Student will be able to design object oriented programs with the concept of object, class, abstraction, encapsulation, inheritance etc. to provide flexibility, modularity and re-usability in programming. They can also be able to design Meta classes and grouping construct.

Module-3:  [11L]
Basic concepts of object oriented programming using Java:
Using objects as parameters, closure look at argument passing, returning objects. [1L]; Introducing access control, Final keyword, garbage collection, Nested and inner classes. [1L]; Class abstraction and encapsulation, Overloading of methods (overloading of constructor). [1L]; Super class, subclasses, super keyword, inheritance, types, member access. [1L]; Multilevel hierarchy, process of constructor calling in inheritance. [1L]; Overriding methods, overriding vs. overloading, polymorphism. [1L]; Abstract class, interface & comparison between abstract class and interface [1L]; Packages, importing packages. [1L]; Exception handling basics, types, using try &catch, throw, throws & finally. [1L]; Threading, synchronization & priorities, thread class, creating thread. [1L]; Basic applet programming. Life cycle. [1L];

Learning outcome of OOP using Java: Students can write programs using Java to implement OOP i.e, encapsulation, polymorphism, aggregation etc., by which they will be able to compare the difference between OOP and other conventional programming languages. They will write programs by using the built-in support for multithreaded programming in java. They will also implement the GUI based event-driven application using Java applets.

Module-4:  [8L]
Fundamentals of Object Oriented design in UML:
Introduction to UML: Why Modeling, Overview of UML, Conceptual Model, Architecture of UML [1L]; UML Modeling Types: Structural Modeling, Behavioral Modeling, Architectural Modeling [1L]; Basic Notations in UML [1L]; Class Diagram [1L]; Interaction and Collaboration Diagrams. [1L]; Sequence Diagram. [1L]; State chart Diagram and Activity Diagram. [1L]; Implementation Diagram and UML extensibility-model constraints [1L]

Learning outcome of Object oriented design in UML:
Student will be able to design software through UML diagrams and identify the components of object oriented design and develop the relationship among them. They can also able to use UML to design software like Payroll Management System, Library Management System etc.

Textbooks/References:
1. Rambaug, James Michael, Blaha,”Object Oriented Modelling and Design”–Prentice Hall, India
3. Patrick Naughton, Herbert Schildt,”The complete reference-Java2”-TMH

Computer organization
Code: BME-504C
Contacts: 3L + 1T  Credits: 4

Module – 1:  [8L]
Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle. Concept of operator, operand, registers and storage. Instruction format. Instruction sets and addressing modes. [7L] Commonly used number systems. Fixed and floating point representation of numbers. [1L]

Module – 2:  [8L]
Fixed point multiplication - Booth's algorithm. [1L]  
Fixed point division - Restoring and non-restoring algorithms. [2L]  
Floating point - IEEE 754 standard. [1L]

Module – 3: [10L]
Memory unit design with special emphasis on implementation of CPU-memory interfacing. [2L] Memory organization, static and dynamic memory, memory hierarchy, associative memory. [3L] Cache memory, Virtual memory. Data path design for read/write access. [5L]

Module – 4: [10L]
Design of control unit - hardwired and microprogrammed control. [3L] Introduction to instruction pipelining. [2L] Introduction to RISC architectures. RISC vs CISC architectures. [2L] I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]

Learning Outcome:
Additional Tutorial Hours will be planned to meet the following learning outcome.

Through this course, the students will be exposed to extensive development and use of computer organization based concepts for the future knowledge outcome of Advanced Computer Architecture offered in subsequent semester. The students will be able to understand different instruction formats, instruction sets, I/O mechanism. Hardware details, memory technology, interfacing between the CPU and peripherals will be transparent to the students. Students will be able to design hypothetical arithmetic logic unit.

Text Book:

Reference Book:
3. N. senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers” OUP

Practical

Biomedical Instrumentation Lab
Code: BME 591
Contacts: 3P    Credits: 2

List of experiments:
1. Power isolation: isolation transformer and DC-DC converters
2. Timer circuits: ON delay and OFF delay study
3. Characterization of biopotential amplifier for ECG & EMG signals
4. Isolation of bio-signal (EMG / ECG)
5. EMG processing and analysis
6. EMG processing and analysis
7. EEG processing and analysis
8. ECG processing and analysis / electronic stethoscope
9. Detection of QRS component from ECG signals
10. Measurement of heart rate using F-V converter

Biomedical Equipments Lab
Code: BME 592
Contacts: 3 P    Credits: 2

[Demonstration and /or study of working of the following biomedical equipments to understand the applications & technology involved in these equipments- using student training kits & simulator.]

List of experiments:
1. Study on colorimeter
2. Study on flame photometer
3. Study on spectrophotometer
4. Study on autoanalyzer / cell counter
5. Study on electronic BP and calibration procedure
6. Study of ultrasonic devices - transmitter and detector
7. Study of blood flow velocity measurement - ultrasonic method
8. Study on pulmonary function analyzer - spirometer
9. Study on respiratory rate meter & apnea detection
10. Study on pulse oximeter
Communication Engineering Lab  
Code: BME 593  
Contact: 3P  
Credit: 2  

List of experiments:  
1. Measurement of MI of an AM signal  
2. Study of SSB modulation and demodulation technique  
3. Study of DSB modulation and demodulation technique  
4. Measurement of bandwidth of a FM signal  
5. Study of phase locked Loop (PLL)  
6. Study process of PAM and demodulation technique  
7. Study of PCM coder and decoder  
8. Study of PSK modulation and demodulation technique  
9. Study of FSK modulation and demodulation technique  
10. Study of Time Division Multiplexing (TDM) and Demultiplexing

Data Structure & C Lab  
Code: BME-594A  
Contacts: 3  
Credits: 2  

Experiments should include but not limited to:  
- Implementation of array operations:  
- Stacks and Queues: adding, deleting elements  
- Circular Queue: Adding & deleting elements  
- Merging Problem:  
- Evaluation of expressions operations on Multiple stacks & queues:  
- Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:  
- Polynomial addition, Polynomial multiplication  
- Sparse Matrices: Multiplication, addition.  
- Recursive and Nonrecursive traversal of Trees  
- Threaded binary tree traversal. AVL tree implementation  
- Application of Trees. Application of sorting and searching algorithms  
- Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Object Oriented Programming & JAVA Lab  
Code: BME-594B  
Contacts: 3  
Credits: 2  

Assignments on class, constructor, overloading, inheritance, overriding  
Assignments on wrapper class, vectors, arrays  
Assignments on developing interfaces- multiple inheritance, extending interfaces  
Assignments on creating and accessing packages  
Assignments on multithreaded programming, handling errors and exceptions, applet programming and graphics programming  

Note: Use Java for programming.

Computer Organization Lab  
Code: BME-594C  
Contacts: 3  
Credits: 2  

Familiarity with IC-chips, e.g.  
a) Multiplexer, b) Decoder, c) Encoder  
Truth Table verification and clarification from Data-book.  
Design an Adder/Subtractor composite unit.  
Design a BCD adder.  
Design of a ‘Carry-Look-Ahead’ Adder circuit.  
Use a multiplexer unit to design a composite ALU.  
Use ALU chip for multibit arithmetic operation.  
Implement read write operation using RAM IC.  
(a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.
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SEMESTER - VI
Theory

Principles of Management
HU-601

Credits: 2L
1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.
2. Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation
   Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational
   Effectiveness.
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity,
   Entrepreneurship
   Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting,
   Regression Analysis, Statistical Quality Control.
    Management, TQM, Kaizen & Six Sigma, MIS.

Readings:

Therapeutic Equipments
Code: BME 601
Contact: 3L Credit: 3

Cardiac Pacemakers & Defibrillators: Effects of electric field on cardiac muscles and laws of stimulation, Need for pacemaker,
   External pacemakers, Implantable pacemakers and types, codes for pacemakers, Pulse generator and Power sources, Electrodes and
   leads system, Pacing system analyzers, Programmable pacemakers, Rate-responsive and ventricular synchronous pacemakers,
   Microprocessor based modern pacemakers, Need for defibrillators, DC defibrillator, Synchronous operation, Implantable defibrillators,
   defibrillator analyzers and safety.

Ventilators & Anaesthetic system: Artificial ventilations, Ventilators and types, Terminology of ventilators, Classification of ventilators
   and modern ventilators, Need for anaesthesia, Anaesthesia gases and vapors, Anaesthesia delivery system, Humidifiers, Nebulizers and
   Aspirators.

Physiotherapy & Electrotherapy Equipments: IR diathermy, UV diathermy, Short wave diathermy, Microwave diathermy, Ultrasonic
   diathermy, Electrotherapy and different waveforms, Electrode system, Electrical stimulators and types, Nerve-muscle stimulators,
   Ultrasonic stimulators, Pain relief through electrical stimulators.

Surgical Diathermy & LASER: Principles and applications of surgical diathermy, Electrosurgery machine, electrosurgery circuits,
   Different electrodes, Electrosurgery techniques, solid state electrosurgery, generator circuits, Testing of Electrosurgery units,
   Electrosurgery safety, Basic principle of ultrasonic lithotripter and extracorporeal shock wave lithotripter, Principle operation of LASER,
   various application of CO2, Ar, He -Ne, Nd – YAG & pulsed ruby LASER, Application of LASER in surgery.

Neonatal Care and Drug Delivery Systems: Baby incubator, radiant warmer and phototherapy unit, Suction apparatus, Infusion
   pumps, Syringe pumps, Peristaltic pumps, Implantable infusion pumps, Programmable volumetric pumps.

Text Books:
3. J.Webster, “Bioinstrumentation”, Wiley & Sons

References:
2. Willard Van Nostrand, “ Instrumental Methods of Analysis”-
6. Leslie Cromwell, " Biomedical Instrumentation and Measurements"

Total 34L
### Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

**Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011**

9. Ward’s Anaesthesia Equipments-4th Ed-Edited by C Ward

#### Biomedical Digital Signal Processing

**Code:** BME 602  
**Contact:** 3L  
**Credit:** 3

<table>
<thead>
<tr>
<th>Text Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Wills J. Tompkins, ”Biomedical digital signal processing”, Prentice Hall of India Pvt. Ltd.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
</tr>
</thead>
</table>

#### Medical Imaging Techniques

**Code:** BME-603  
**Contact:** 3L  
**Credit:** 3

<table>
<thead>
<tr>
<th>Text Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Computer technique in medicine. Macfarlane P.W. Butter Worth</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Reference</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Medical Imaging Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X-ray Machine:</strong> Physics and production of X-ray, Stationary and rotating anode tube, tube enclosure, rating charts of X-ray tubes, Conventional electrical circuit of X-ray machine, High voltage generation, High frequency generators, Control circuits-high voltage control, filament control and tube current, starter, exposure timing, Automatic exposure control, Collimators and Grids, mammographic and dental X-ray machines, portable and mobile X-ray units.</td>
</tr>
<tr>
<td><strong>X-ray image and radiotherapy:</strong> X-ray film, Film sensitometry, Radiographic film image formation, dark room accessories-developer and fixer, image quality factors, detector quantum efficiency, MTF, Image intensifier, Digital radiography, safety protocol and doses, Dose equivalent and REM, Radiotherapy principles, dose measurement and treatment planning.</td>
</tr>
<tr>
<td><strong>Fluoroscopy and angiography:</strong> Fluoroscopic imaging system, Digital fluoroscopy-c-arm system, Digital subtraction angiography (DSA), digital subtraction programming, angioplasty.</td>
</tr>
<tr>
<td><strong>Infra red Imaging:</strong> Physics of thermography, Infrared detectors, Imaging systems, clinical thermography, liquid crystal thermography, modern application.</td>
</tr>
</tbody>
</table>

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**Total** 34 L
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
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**Computed tomography:** Principles of computed tomography. Scanning system, Detectors, Processing / data acquisition system, viewing system, storing & documentation, gantry geometry. Different information from gantry, CT numbers, image reconstruction techniques: back projection, iterative and analytical methods, image quality and artifacts, Dose in CT, Spiral CT.

**Text Books:**
3. J.Webster, “Bioinstrumentation”, Wiley & Sons

**References:**

**Microprocessors & Microcontrollers**

**Code:** BME-604A
**Contact:** 3L + 1T
**Credits:** 4

Introduction to Microcomputer based system. History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. 1L

Architecture of 8085 Microprocessor. Address/data bus demultiplexing, status Signals and the control signal generation. Instruction set of 8085 microprocessor, Classification of instruction, addressing modes, timing diagram of the instructions (a few examples). 7L

Assembly language programming with examples, Interrupts of 8085 processor, programming using interrupts. 5L

Serial and parallel data transfer – programmed I/O, interrupts driven I/O, DMA, asynchronous and synchronous serial transmission using SID and SOD pins of 8085 processor. 2L

Introduction to MCS-51 microcontroller –Architecture, pin details, memory organization, Hardware features of MCS-51, external memory interfacing, timers, interrupts, power management, serial port, addressing modes, assembly language programming. 5L

THE 8086 microprocessor- Architecture, pin details, addressing modes, instruction set, Assembly language programming interrupts. 3L

Support IC chips- 8255, 8253, 8259, 8279 and 8251 and their interfacing with 8085, 8086 and microcontroller 8051. 8L

Keyboard and Multiplexed display, LCD interfacing, with 8085, 8086, and 8051. 3L

Memory interfacing with 8085, 8086, and 8051- ADC and DAC interfacing with the processor 8085, 8086 and 8051. 2L

Brief introduction to PIC microcontroller (16F877) 1L

**Texts:**
1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanaan and Jeevananthan (Oxford univ.press)
2. 8051 Microcontroller – K. Ayala (Cengage learning)
3. MICROPROCESSOR architecture, programming and Application with 8085 - R.Gaonkar (Penram international Publishing LTD.)
4. 8051 Microprocessor –V. Udayashankara and M.S Mallikarjunaswami (TMH).
5. Microprocessor 8085 and its Interfacing—S Mathur (PHI)
6. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan)

**Reference:**
1. The 8051 Microcontroller – K Ayala (Cengage learning)
2. The 8051 Microprocessor, Architecture, Programming and Interface- K Uday Kumar, B.S Umashankar (Pearson)
3. The X-86 PC Assembly language, Design and Interfacing - Mazidi, Mazidi and Caussey (PEARSON)
4. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

**Microelectronics & VLSI Designs [Same as ECE-702 or EE-604(c)]**

**BME-604B**
**Contact:** 3L + 1T
**Credits:** 4
## Electronic Measurement and Instrumentation

**Code:** BME 605A  
**Contact:** 3L  
**Credit:** 3

<table>
<thead>
<tr>
<th>Basic Measurement Concepts:</th>
<th>6L</th>
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<table>
<thead>
<tr>
<th>Signal Generator and Analysis:</th>
<th>7L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function Generators- RF Signal Generators- Sweep Generators – Frequency Synthesizer-Wave Analyzer- Harmonic Distortion Analyzer – Spectrum Analyzer</td>
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</table>

<table>
<thead>
<tr>
<th>Digital Instruments:</th>
<th>7L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of analog &amp; digital techniques- digital voltmeter- multimeter – frequency counters-measurement of frequency and time interval – extension of frequency range- measurement errors.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Acquisition Systems:</th>
<th>7L</th>
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</table>

**Total:** 34L

### Books:

## Database Management System

**BME-605B**  
**Contact:** 3L  
**Credits:** 3

<table>
<thead>
<tr>
<th>Introduction [4L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept &amp; Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.</td>
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<thead>
<tr>
<th>Entity-Relationship Model [6L]</th>
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<tbody>
<tr>
<td>Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.</td>
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<thead>
<tr>
<th>Relational Model [5L]</th>
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<tbody>
<tr>
<td>Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.</td>
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</table>

<table>
<thead>
<tr>
<th>SQL and Integrity Constraints [8L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of DDL, DML, DCL, Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relational Database Design [9L]</th>
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<tbody>
<tr>
<td>Functional Dependency, Different anomalies in designing a Database, Normalization using functinal dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internals of RDBMS [7L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical data structures, Query optimization : join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>File Organization &amp; Index Structures [6L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>File &amp; Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .</td>
</tr>
</tbody>
</table>

### Text Books:

24
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011

5. Jain: Advanced Database Management System CyberTech

Reference:

Operating System
Code: BME-505C Contact: 3L Credits: 3

Introduction [4L]
Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, timesharing, real-time, distributed, parallel.

System Structure[3L]
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls.

Process Management [17L]
Processes [3L]: Concept of processes, process scheduling, operations on processes, co-operating processes, interprocess communication.
Threads [2L]: overview, benefits of threads, user and kernel threads.
CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization [3L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Storage Management [19L]
Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.
Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN), disk reliability, disk formatting, boot block, bad blocks.

Protection & Security [4L]
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Text Books / References :
4. Dhamdhere: Operating System TMH

Biomedical Instruments Lab
Code: BME 691 Contacts: 3P Credits: 2

[Demonstration and for study of working of the following biomedical instruments to understand the applications & technology involved in these instruments- using student training kits & simulator.]

List of experiments:
1. Pacemaker Circuits / Pacemaker simulator
2. Lead selection circuits
3. Study on simulated DC defibrillator
4. Study on muscle stimulator
5. Study on ultrasound diathermy unit

Practical
## Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

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6. Study on X-ray radiography systems / X-ray simulator
7. Study on bio-telemetry system
8. Study on pulse rate meter
9. Study on Baby incubator / Infusion pump
10. Study on EMG biofeedback system

### Biomedical Digital Signal Processing Lab

**Code:** BME 692  
**Contact:** 3P  
**Credit:** 2

[The following experiments to be conducted using Matlab/C]

**List of experiments:**
1. Find out DFT of a Step Sequence.
5. Frequency Response, Phase Response & Magnitude Response of all types of IIR filter.
6. Auto-Correlation and Cross-Correlation of ECG signals.
9. DCT and IDCT of ECG signal.
10. FFT and IFFT of ECG signals
11. 60-Hz adaptive filter
12. Reduction of ECG signal

### Microprocessors & Microcontrollers Lab

**Code:** BME-694A  
**Contact:** 3P  
**Credits:** 2

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Experiments</th>
<th>No. of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical) Assignments based on above.</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>a) Familiarization with 8085 &amp; 8051 simulator on PC. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the simulator. Assignments based on above</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Programming using kit and simulator for: i) Table look up ii) Copying a block of memory iii) Shifting a block of memory iv) Packing and unpacking of BCD numbers v) Addition of BCD numbers vi) Binary to ASCII conversion vii) String Matching, Multiplication using shift and add method and Booth’s Algorithm</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Study of timing diagram of an instruction on oscilloscope.</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Study of 8051 Micro controller kit and writing programs as mentioned in S/L3. Write programs to interface of Keyboard, DAC and ADC using the kit.</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Serial communication between two trainer kits</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total 30 hours (10 classes each of 3 periods)**

### VLSI Design Lab [Same as EC-792]

**Code:** BME 694B  
**Contacts:** 3P  
**Credits:** 2
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year
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Biomaterials & Tissue Engineering
Code: BME 701
Contacts: 3L
Credits: 3

**Characterization and Properties of Biomaterials:** Introduction to biomaterials, Basic criteria for biomaterials, classification of biomaterials, selection and performance of biomaterials, biological responses, mechanical properties-stress strain behaviour and hardness, mechanical failures, electrical properties and piezoelectricity, optical properties, surface and physical properties.


**Polymeric & Composite Biomaterials:** Polymerization and basic structure, Polymeric biomaterials: Polyethylene (PE), Polypropylene (PP), Polyvinylchloride (PVC), Polyamide (Nylon), Polytetrafluoroethylene (PTFE), Polymethylmetacrylate (PMMA), Polyetherether ketone (PEEK), Silicone rubber, Hydrogels, Biodegradable polymers. Various applications of polymers in medical field. Properties and types of composites.

**Biocompatibility & Sterilisation of biomaterials:** Introduction to biocompatibility, blood compatibility and tissue compatibility. Toxicity screening tests of biomaterials, Evaluation of systemic toxicity, haemolysis, cytotoxicity and special tests. Sterilization of implantable biomaterials, Effects of sterilization on material properties.

**Tissue Engineering:** Basic principles and strategies of tissue engineering, vascularisation and angiogenesis, Different cell types, progenitor cells and cell differentiations, Cell culture and storage, different kind of matrix (ECM), cell-cell interaction. Cell signaling molecules, growth factors, Cell surface markers, cell adhesion, receptor-ligand binding, Scaffold and engineering materials, 3-D architecture and cell incorporation, bioreactors, Tissue engineering applications, Inflammatory and Immune responses to tissue engineered devices, Fundamental of Stem Cell tissue engineering.

**Total** 36L

Test books

References
7. Frederick H. Silver, Biomaterials, Medical devices and Tissue Engineering, Chapman & Hall

Biomechanics & Implants
Code: BME 702
Contacts: 3L
Credits: 3
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011


Text Books
2. D. Dawson & V. Wright, Introduction to Biomechanics of joints and joint replacement
3. D N Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982

References
1. D.O. Cooney, Biomedical Engineering Principles, Macel Dekker, INC, Newyork
2. A. Z. Tohen and C T. Thomas, Manual of Mechanical Orthopaedics

Medical Image Processing
Code: BME 703A
Contact: 3L + IT Credit: 4

Digital image fundamentals: Image digitization, sampling and quantization, neighbour of pixels, connectivity, relations, equivalence and transitive closure, distance measures, arithmetic / logic operations, discrete transform, fast Fourier transform, 2-D Fourier transform, inverse Fourier transform.

Image enhancement fundamentals: Spatial domain method, frequency domain method, contrast enhancement, histogram processing, image smoothing, image averaging, masking, image sharpening, removing of blur caused by uniform linear motion, enhancement in the frequency domain: low pass, high pass, mean and band-pass filtering, special examples using CT and MRI.
**Image restoration fundamentals**: Degradation model, discrete formulation, algebraic approach to restoration: unconstrained and constrained.

**Image compression and segmentation fundamentals**: Fidelity criteria, image compression models, lossy and lossless compression technique. Image segmentation: point detection, line detection, edge detection, edge linking and boundary detection, special examples using CT and MRI.

**Morphological Image Processing**: Definition of Morphological Imaging, Different Morphological Operator: Dilation, Erosion, Opening, Closing, Thickening, Thinning, Skeletons, Pruning. Hit-or-Miss Transform.

<table>
<thead>
<tr>
<th>Total</th>
<th>4L</th>
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<tbody>
<tr>
<td></td>
<td>10L</td>
</tr>
<tr>
<td></td>
<td>8L</td>
</tr>
</tbody>
</table>

**Text books**:
2. Chanda & Majumdar, Digital image processing and analysis, PHI
3. Jain, Fundamental of digital image processing, PHI

**References**
3. Tou and Gonzalez, Pattern recognition

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**Adaptive Signal Processing**

Code: BME 703B  
Credit: 4

<table>
<thead>
<tr>
<th>Module-I</th>
<th>10L</th>
</tr>
</thead>
</table>
| **Introduction**: Adaptive Systems – Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications  
**The Adaptive Linear Combiner**: Performance function, Gradient and Mean Square Error, Examples. |

<table>
<thead>
<tr>
<th>Module-II</th>
<th>14L</th>
</tr>
</thead>
</table>
| **Theory of Adaptation with Stationary Signals**: Properties of the Quadratic Performance Surface, Significance of eigen values, eigenvectors, correlation matrix.  
**Searching the Proformance Surface**: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve  
**Gradient Estimation and its effects on Adoption**: The performance penalty, Variance of the gradient estimate, Misadjustment. |

<table>
<thead>
<tr>
<th>Module-III</th>
<th>16L</th>
</tr>
</thead>
</table>
| **Adaptive Algorithms and Structures**: The LMS Algorithm, Convergence, learning Curve, Performance analysis, Filtered X LMS algorithm,  

| Total     | 40L |

**Text Books**:

**Reference Book**:
### Advanced Medical Imaging Techniques
**Code:** BME 704A  
**Contact:** 3L  
**Credit:** 3

**Ultra Sound Imaging System:** Physics and production of ultrasound, Medical ultrasound, acoustic impedance, absorption and attenuation of ultrasound energy, pulse geometry, ultrasonic field, ultrasonic transducers and probe design, principles of image formation, image processing, display system: A-mode, B-mode and M-mode. Real-time ultrasonic imaging systems, electronic scanners, image artifacts, Doppler ultrasound and Colour velocity mapping, duplex ultrasound, bio-effects and safety levels.

**Magnetic Resonance Imaging System:** Principles of nuclear magnetism, RF magnetic field and resonance, Magnetic resonance (MR) signal, nuclear spin relaxations, gradient pulse, slice selection, phase encoding, frequency encoding, spin echoes, gradient echoes, K-space data acquisition and image reconstruction. MRI scanner hardware: magnet, gradient coil, RF pulse transmission and RF signal reception. Diagnostic utility and clinical MRI, functional MRI, magnetic resonance angiography (MRA), magnetic resonance spectroscopy (MRS), diffusion MRI, bio-effects and safety levels.

**Nuclear Medical Imaging System:** Radio nuclides for imaging, nuclear decay and energy emissions, brief of radionuclide production and detectors, pulse height analyzer, uptake monitoring equipments, Rectilinear scanners, Gamma Camera, Single-photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET).

**Clinical Applications:** Clinical aspects of PET/CT and SPECT/CT, cone beam CT for radiotherapy, perfusion CT, spiral CT, multi-slice CT, functional brain imaging, bone marrow scanning, CSF imaging, Thyroid and parathyroid imaging, Liver and spleen imaging.

### Text Books:

6. J. Webster, “Bioinstrumentation”, Wiley & Sons

### References:


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<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Contact</th>
<th>Credit</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra Sound Imaging System</td>
<td></td>
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<td>10L</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging System</td>
<td></td>
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<td>14L</td>
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<tr>
<td>Nuclear Medical Imaging System</td>
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<td>6L</td>
</tr>
<tr>
<td>Clinical Applications</td>
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<td>6L</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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<td><strong>36L</strong></td>
</tr>
</tbody>
</table>

### Virtual Instrumentation
**Code:** BME 704B  
**Contact:** 3L  
**Credit:** 3

**Review of Virtual Instrumentation:** Historical perspectives, Need of VI, advantages, Define VI, block diagram and architecture of a
virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming.

**VI Programming Techniques:** VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Graphical programming in data flow, comparison with conventional programming.

Data Acquisition Basics: ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. GPIB/IEEE 488 concepts, and embedded system buses - PCI, EISA, CPCI, and USB & VXI.

Common Instrument Interfaces: Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, Visa and IVI, image acquisition and processing. Motion control. ADC, DAC, DIO, DMM, waveform generator.

Use of Analysis Tools: Fourier transforms, power spectrum correlation methods, windowing & filtering, Major equipments- Oscilloscope, Digital Multimeter, Pentium Computers, Application in Biomedical field.

<table>
<thead>
<tr>
<th>Text Books:</th>
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</table>

<table>
<thead>
<tr>
<th>Reference Books:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Technical Manuals for DAS Modules of Advantech and National Instruments</td>
<td></td>
</tr>
<tr>
<td>4. L.T. Amy, Automation System for Control and Data Acquisition , ISA, 1992</td>
<td></td>
</tr>
</tbody>
</table>

**Power & Control System**

**Code:** BME 705A  
**Contact:** 3L + IT  
**Credit:** 4  

<table>
<thead>
<tr>
<th><strong>Thyristor:</strong> Introduction, Thyristor family, Principles of operations of SCR, Two transistor model of SCR, Gate characteristics, Turn on &amp; off methods of Thyristor, Firing of Thyristor, Gate trigger circuits. Brief of modern power semiconductor devices: DIAC, TRIAC, GTO, RCT, SIT, LASCR, IGBT, MOSFET, UJT.</th>
<th>10L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase Control Rectifiers and Inverters:</strong> Introduction, Phase angle control, 1-Phase half &amp; full wave control rectifier, 3-Phase half &amp; full controlled bridge converter, Thyristor Inverter classification: Series Inverters, Parallel Inverters, 1-Phase &amp; 3-Phase bridge inverters.</td>
<td>8L</td>
</tr>
<tr>
<td><strong>Choppers and AC Regulators:</strong> Principle of operation, Step up/down chopper, Chopper Configuration, AC Chopper, 1-Phase &amp; 3- phase AC Regulator.</td>
<td></td>
</tr>
<tr>
<td><strong>Feedback Characteristics:</strong> Open and closed loop, Mathematical models of physical systems, Transfer function, Block diagram algebra, Signal flow graphs, Feed back &amp; non feed back systems, Regenerative feedback.</td>
<td>6L</td>
</tr>
<tr>
<td><strong>Control system components:</strong> Error sensing devices, potentiometer, tachometer, servomotors, stepper motor, Hydraulic system, Pneumatic System, P, PI and PID controller.</td>
<td>4L</td>
</tr>
<tr>
<td><strong>Time Domain and Frequency Domain Analysis:</strong> Introduction, Time response to 1st order &amp; 2nd order systems, Effect of adding pole zeros to TF, R-H criteria, Root Locus method, Frequency response plot: Polar Plots, Bode Plots, Nyquist Criteria.</td>
<td>6L</td>
</tr>
<tr>
<td>Total</td>
<td>36L</td>
</tr>
</tbody>
</table>
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**Text/ Reference books:**
2. Power Electronics – Mohan, Undeland & Robbins – John Willey & Sons
3. Power Electronics – Vedam Subhramanyam – New Age International
7. Modern Control Engineering – K. Ogata – PHI

Biological Control System & Modelling
Code: BME 705B
Contact: 3L + IT Credit: 4

**Introduction:** Technological control system, transfer function, mathematical approaches, system stability, similarities between biological and engineering control system, technique of mathematical modelling, importance of physiological modelling and signal analysis, linearization of nonlinear models, Time invariant and time varying systems for physiological modelling.

**Process regulation:** Acid-base balance, extra-cellular water and electrolyte, interstitial fluid volume, blood pressure, blood glucose, CO₂, thermal regulatory system.

**Biological control:** Cardiac rate, blood pressure, respiratory rate, mass balancing of lungs, oxygen uptake by RBC and pulmonary capillaries, oxygen and carbon dioxide transport in blood and tissues, urine formation and control, Pupil control systems, skeletal muscle servomechanism, and semicircular canal. Free swinging limbs, Endocrine control system.

**Physiological modelling:** Hodgkin and Huxley’s model of action potential, Huxley model of isotonic muscle contraction, modeling of EMG, modeling of ECG Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop and Linearized model of the immune response.

**Text / Reference Books:**
2. Brell and Guyton, Regulation and control in physiological system,
4. Milhorn T.H. Saundra. Application of control theory to physiological systems,

Artificial Intelligence & Pattern Recognition
Code: BME 705C
Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year

Contact: 3L + IT  
Credit: 4

INTRODUCTION TO AI: Definition of Artificial Intelligence, History and Applications, Components of AI Structures and Strategies for state space search- Data driven and goal driven search, Depth First and Breadth First Search, DFS with Iterative Deepening, Heuristic Search- Best First Search, A* Algorithm, Constraint Satisfaction.  

KNOWLEDGE REPRESENTATION IN AI: Knowledge representation - Propositional calculus, Predicate Calculus, Theorem proving by Resolution, Answer Extraction, AI Representational Schemes- Semantic Nets, Conceptual Dependency, Scripts, Frames.  

PATTERN RECOGNITION CONCEPTS: Introduction to statistical, syntactic and descriptive approaches, features and feature extraction, learning, Bayes Decision theory- introduction, continuous case, 2-category classification, minimum error rate classification, classifiers, discriminant functions, and decision surfaces. Error probabilities and integrals, normal density, discriminant functions for normal density, Bayes Decision theory Discrete case.  

LINEAR DISCRIMINANT FUNCTIONS: Linear discriminant functions- linear discriminant functions and decision surfaces, generalized linear discriminant functions, 2-category linearly separable case, non-separable behavior, linear programming procedures.  

SUPERVISED LEARNING AND CLUSTERING: Supervised learning and clustering- Mixture densities and identifiably, Maximum likelihood estimates, application to normal mixtures, unsupervised Bayesian learning, data description and clustering, Hierarchical clustering, low dimensional representation of multidimensional map.  

TEXT BOOKS  
1. GEORGE.F.LUGER, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, 2002, Pearson Education  
2. Duda and Hart P.E, Pattern classification and scene analysis, John wiley and sons, NY, 1973  

REFERENCE BOOKS  
1. Earl Gose, Richard Johnsonbaugh, and Steve Jost; Pattern Recognition and Image Analysis, PHI Pvt. Ltd., New Delhi-1, 1999  

Group Discussion & Seminar  
Code: HU 791  
Contacts: 3P  
Credits: 2

Biomaterials & Biomechanics Lab  
Code: BME 791  
Contacts: 3P  
Credits: 2

List of Experiments:  
1. Mechanical characterization of metallic biomaterials  
2. Mechanical characterization of polymeric biomaterials  
3. Hardness testing of biomaterials  
4. Surface roughness measurement of biomaterials  
5. Estimation of haemocompatibility of biomaterials by hemolysis studies  
6. Measurement of torque required to tap and screwing in jaw bone.  
9. Stress-strain analysis of hip prosthesis  
10. Ultrasonic characterization of biomaterials-NDE  

Biomedical Instruments & System Lab  
Code: BME 792  
Contacts: 3P  
Credits: 2
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List of experiments:
1. Study on ECG heart rate monitor with alarm system
2. Study on peripheral pulse rate monitor with alarm system
3. Study on digital body/skin temperature monitoring system
4. Spectral analysis of biopotentials - Physiograph
5. Study on multi-parameter monitor
6. Study on cardiac stress analysis
7. Study on US Doppler / Foetal monitor
8. Study on hearing aid and audiometer: air and bone conduction
9. Study on nerve conduction velocity measuring system
10. Study on ECG simulator and servicing of ECG machine

Medical Image Processing Lab
Code: BME 793A
Contacts: 3P Credits: 2
List of experiments:
[Students are required to perform at least EIGHT experiments]
1. Image enhancement – Histogram
2. Image smoothing
3. Image sharpening
4. Point detection
5. Line detection
6. Edge detection
7. Image data compression
8. Image Characterization
9. Vector & Matrix Indexing
10. Fourier Transform
11. Image Transformation
12. Morphological Image Processing

Adaptive Signal Processing Lab
Code: BME 793B
Contacts: 3P Credits: 2
List of experiments:
1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.
3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.
4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.
5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.
(ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.
6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.
7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.
(ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.
8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.
9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.
10. (i) Convolution of long duration sequences using overlap add, overlap XXXXX using MATLAB.
(ii) Implementation of noise cancellation using adaptive filters on a DSP kit.
Reference Books:
Organizational Behaviour
Code: HU 801A
Contact: 2L
Credit: 2

<table>
<thead>
<tr>
<th>Organizational Behaviour</th>
<th>Contact</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Importance, History, Concepts, Challenges, Opportunities</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Definition, Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Motivation: Definition, Theories of Motivation - Maslow’s Hierarchy of Needs Theory, McGregor’s Theory X &amp; Y, Herzberg’s Motivation-Hygiene Theory, Alderfer’s ERG Theory, McClelland’s Theory of Needs, Vroom’s Expectancy Theory.</td>
<td>4L</td>
<td></td>
</tr>
<tr>
<td>Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making.</td>
<td>2L</td>
<td></td>
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<tr>
<td>Communication: Communication Process, Direction of Communication, Barriers to Effective Communication.</td>
<td>2L</td>
<td></td>
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<tr>
<td>Leadership: Definition, Importance, Theories of Leadership Styles.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Organizational Politics: Definition, Factors contributing to Political Behaviour.</td>
<td>2L</td>
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<tr>
<td>Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.</td>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>Artificial Organs &amp; Rehabilitation Engineering</td>
<td>Contact: 3L + IT</td>
<td>Credit: 4</td>
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| Introduction to artificial organs: Need of artificial organs, design consideration and evaluation process, artificial heart and engineering design, circulatory assist devices-IABP and SSL, cardiac catheterization, stents, CVP and SWAN catheters, blood substitutes and haemodilution, oxygen carrying and hemoglobin based artificial blood, liver support system, artificial pancreas, artificial skin. | 8L |
| Artificial kidney: Brief of kidney filtration, basic methods of artificial waste removal, dialysis, equation for artificial kidney and middle molecule hypothesis, artificial kidney machine, hemodialyzers: flat plate type, coil type and hollow fiber. Mass transfer in dialyzers, regeneration of dialysate, membrane configuration, portable and implantable artificial kidney machine, electrical safety and maintenance. | 8L |
| Artificial heart-lung machine: Brief of lungs gaseous exchange / transport, artificial heart-lung devices, oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. | 8L |
| Rehabilitation Engineering: Impairments, disabilities and handicaps, measurement and assessment. Engineering concepts in sensory and motor rehabilitation. Rehabs for locomotion, visual and speech. Spinal rehabilitation, ultrasonic binaural sensing aid for the blind, rehabilitation in sports. | 4L |

References:
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
Orthotic and Prosthetic devices: Artificial limb and hands, intelligent prosthetics, externally powered and controlled orthotics and prosthetics, FES system-restoration of standing and walking, hybrid assistive system, Myoelectric hand and arm prostheses. The MARCUS intelligent hand prostheses.


Text / Reference Books:
4. David O. Cooney, Biomedical Engineering Principles (Vol.-II), Marcel Dekker Inc.
7. Dr. S.Sundar, Rehabilitation Medicine, Jaypee Medical Pub., New Delhi.

LASERS and Fiber Optics in medicine
Code: BME 801B
Contact: 3L Credit: 3


Lasers in surgery: Surgical instrumentation of CO2, Ruby, Nd-YAG, He-Ne, Argon ion, Q-switched operations, continuous wave, Quasi-continuous, surgical applications: removal of tumours of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.


Optical Fibres Fundamentals: Principles of light propagation through a fibre, Different types of fibres and their properties, fibre characteristic, transmission of signal in SI and GI fibres, attenuation in optical fibres, Connectors and splicers, Fibre termination, Optical sources, Optical detectors.

Optical Fibre bundles and Applications: Introduction and construction details of optical fibres, non-ordered fiber optic bundles for light guides-fundamentals & principles, ordered fiber optic bundles for imaging devices-fundamentals & principles, fiberscopes and endoscopes-fundamentals, fiber optic imaging systems-advances, optical fiber in communication.

Test Books:
5. Nandini K. Jog, “Electronics in medicine and biomedical instrumentation”, PHI

Health Technology Management
**Syllabus for B.Tech (Bio Medical Engineering) up to Fourth Year**

**Revised Syllabus of B.Tech in BME for the students who were admitted in Academic Session 2010-2011)**

**Code:** BME 802A  
**Contact:** 3L + IT  
**Credit:** 4

| **Healthcare System:** |  
| Health organization of the country, health technology and challenges in maintaining normal health, management of Indian Hospitals- challenges and strategies, modern techniques of hospital management. |

| **Hospital Organization:** |  
| Classification of hospitals, role of hospital in healthcare, location and environment of hospital, wards, intensive care units, admitting department, medical record department, centralized sterilization and supply department, pharmacy, food services, laundry and linen services, house-keeping, evaluation of hospital services. |

| **Planning and Designing of Medical Services:** |  
| Outpatient service, inpatient service, emergency service, clinical laboratories, radiology services, radiation therapy department, surgical department, critical care department, nursing department, operation theatre, CSSD, nursing services, blood banks. |

| **Planning and Designing of Engineering Services:** |  
| Engineering department, Maintenance department, clinical (biomedical) engineering, preventive maintenance of equipments, electrical system, power supply system, air condition system, water supply and sanitary system, centralized gas supply system, telecommunication system, environmental control, safety and security system, fire safety and threat alarm system, hospital waste disposal system. |

| **Hospital Management and Information System:** |  
| Role of HMIS, functional areas, modules forming HMIS, HMIS and internet, PACS, radiology information system, health information system, centralized data record system, computerized patient records, computer assisted patient education and healthcare information, material management, disaster management. |

| **Regulation and Planning of New Hospital:** |  
| FDA regulation, accreditation for hospitals, ISO certification, fire protection standard, IRPC, planning and design of new hospital, guiding principle, facilities & services, function plans for hospital construction. |

| **Text / Reference Books:** |  
4. Hans Pfeiff, Vera Dammann (Ed.) *Hospital Engineering in Developing Countries*, Z report Eschborn, 1986  

**Medical Informatics**

| **Code:** BME 802B  
**Contact:** 3L  
**Credit:** 3

| **Introduction:** |  
| Structure of Medical Informatics, Internet and Medicine, Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics, Medical Informatics, Bioinformatics |

| **Computerized Patient Record:** |  
| History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology, Application server provider, Clinical information system, Computerized prescriptions for patients. |

| **Computers in Clinical Laboratory and Medical Imaging:** |  
| Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System, Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance |

| **Computer Assisted Medical Decision-Making:** |  
| Neuro-computers and Artificial Neural Networks application, Expert system, General model of CMD, Computer-assisted decision support system, production rule, system cognitive model, semester networks , decisions analysis in clinical medicine, computers in the care of critically patients, computer assisted surgery, designing. |

| **Recent Trends in Medical Informatics:** |  
| Virtual reality applications in medicine, Computer assisted surgery , Surgical simulation, Telemedicine, Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics, Computer assisted patient education and health, Medical education and health care information. |

| Total | 40L |
Text/Reference Books:

Neural Network and Fuzzy Logic Control
BME 802C
Contracts: 3L Credits: 3

| Neural network for control: Schemes of neuro-control, identification and control of dynamical system, Neural controller for a temperature process. |
| Fuzzy logic control systems: Fuzzy logic control, Fuzzification, defuzzification, knowledge base, decision making logic, design of Fuzzy logic controller, case study. |

Text/Reference Books:
3. Klir G.J. and Folger T.A., Fuzzy sets, Uncertainty and Information, PHI